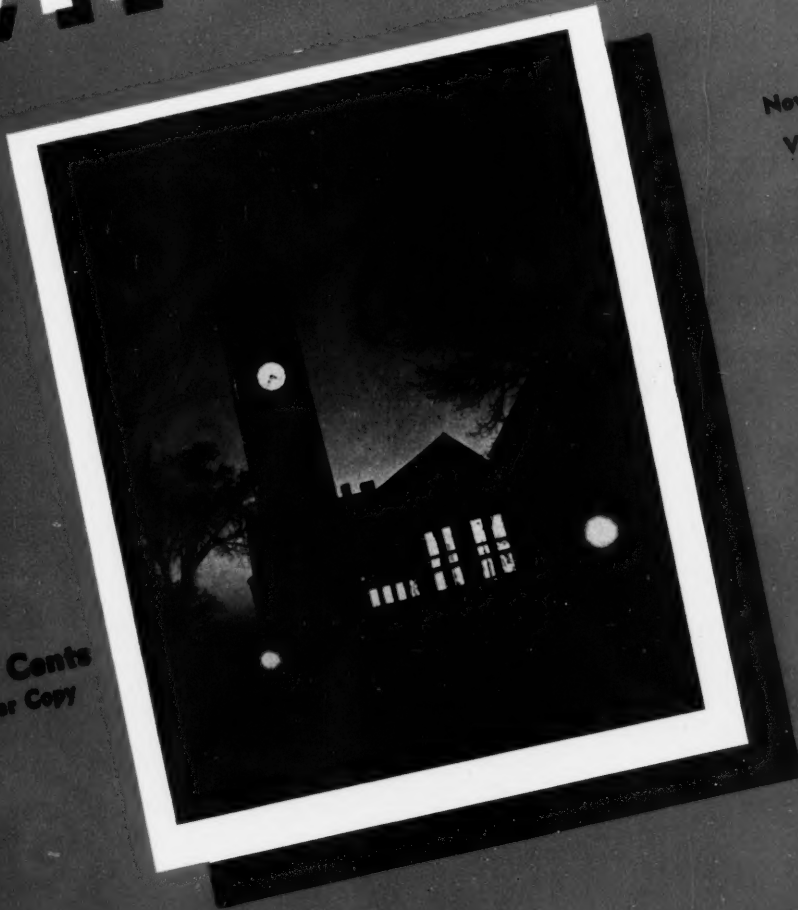


# THE CORNELL ENGINEER

November, 1950  
Vol. 16, No. 2

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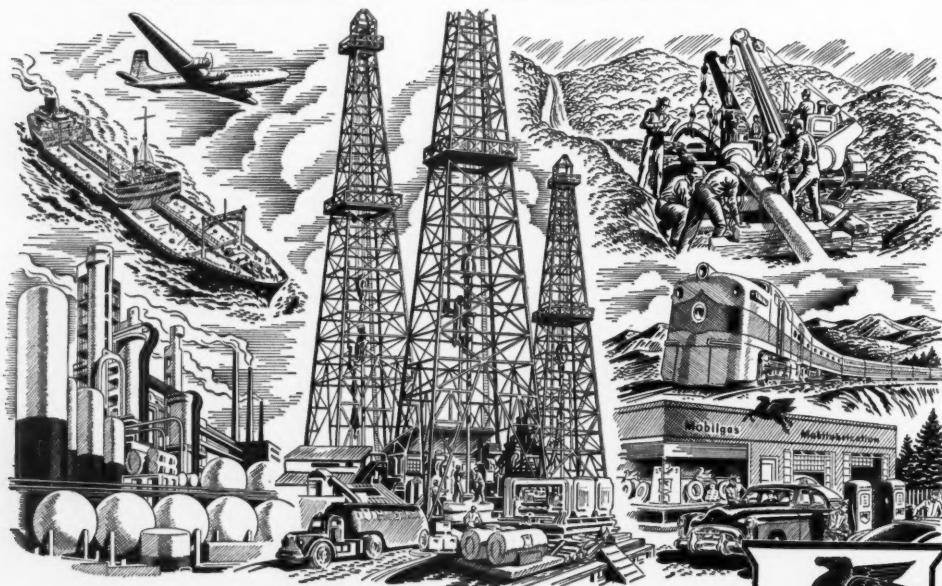
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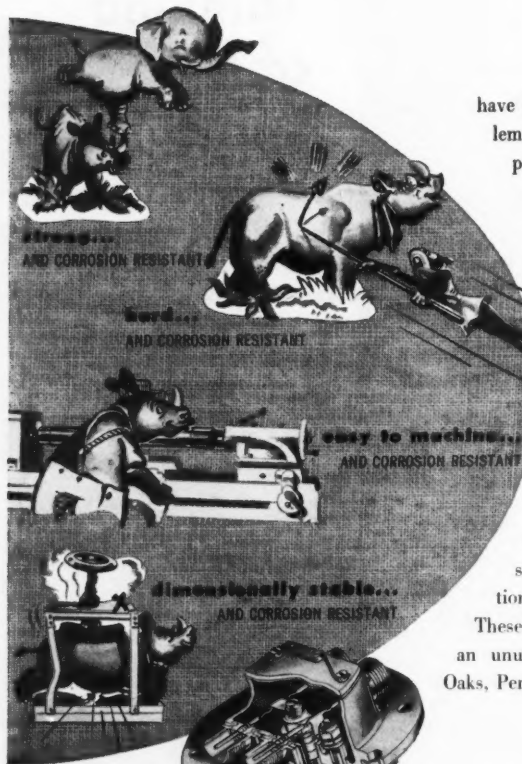
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# Watch Dog Of The Nation

By IRWIN B. MARGILOFF, ChemE '53



*Photos courtesy Underwriter's Laboratories*

Because fire is at the same time one of the most costly of contemporary wastes and yet one of the most easily accessible, a great testing organization has been set up to attack the problem of reducing fire losses. That organization is the Underwriters' Laboratories, which has its main testing plant in Chicago. There, engineers, by testing the thousands of products submitted, systematically study their behavior to make certain that they will not cause fires under the most extremely trying conditions, and, if they are to put a fire out, that they be able to do that job efficiently. Fire's only virtue—that of systematic elimination—is well demonstrated.

Underwriters' history began in 1893, when William Henry Merrill, a young engineer, was hired by the insurance industry of Boston to investigate all the fires occurring at the Columbian Exposition in Chicago, and to determine the cause of any electrical failure resulting in a fire. At the same time, the insurance industry was sponsoring an in-

vestigation by William C. Robinson of automatic sprinklers. The two engineers soon met and merged their work. Soon after, in 1894, Merrill became the founder, and later the president, of the Underwriters' Laboratories, and Robinson was its chief engineer. As the electrical industry grew, so did Underwriters' Laboratories. Now, in its Chicago facilities, complete laboratories test materials and products represented by Protection, Hydraulic, Gases and Oils, Chemical, Electrical, Casualty and Automotive, and Burglary Protection Departments. Smaller stations are maintained in New York and San Francisco.

Underwriters' Laboratories examines the behavior of articles submitted to it, and compares their performance with the Standards established by its own and industry's engineers to be safe and sufficient for their purposes. In the case of a fixed engineering difference of opinion or any other technical matter between it and any of its clients, the National Bureau of Standards and UL have an arrangement wherein the matter is submitted to the Bureau.

## Purposes of UL

New standards are being established as the need for them arises, or the old ones are outdated. Sometimes, however, engineering data

isn't available for this purpose and Underwriters' Laboratories must determine its own. One good example of its thoroughness in this respect is the procedure adopted in the determination of the maximum safe amount of current the human body could tolerate. There was no place where such information was available, and so engineers, switchboard operators, executives and secretaries took their turns standing in pans of water and holding wires until the accumulated data yielded a research paper and a standard.

This is an example of the basic research that UL sometimes must do. Its purposes are set forth in the Certificate of Incorporation: to test, to publish the results of tests, to label inspected products, to do development work in safety and also basic research, and, should it be liquidated, to set up a trust for the endowment of projects similar to it in aims. It is a non-profit corporation, has no capital stock and no dividends, and none of its assets will ever be distributed to its members. The main reason for the non-profit specification is for the assurance of impartiality. Should a profit be made on fees for the investigations, there might be some incentive for lowering standards to increase business, and this possibility is thus prevented.

Let's take a short tour through

The distribution of water by an automatic sprinkler is determined in this laboratory, whose floor is covered with buckets each of one square foot area.

—Courtesy Underwriter's Laboratories



The cathode-ray oscillograph, beat-frequency generator, and noise meters permit accurate photographic recording of split second operation of sound and electronic detection systems.

parts of the Chicago plant. The heavy machinery is at the very bottom of the five story structure, under Ohio Street. There, a complete hydraulic lab tests pumps, hydrants, hoses and other forms of firefighting equipment. At a slightly higher level is the materials department, where fire walls are built by the lab's own staff, and aged for varying periods before being sealed under load, face-to-face with a wall of gas flames. A few hours later, after the treatment by fire, comes an immediate treatment by cold water. Should the wall succeed in defying the action of the flames and the water as prescribed in the applicable standards, fine. If not, the manufacturer gets a lukewarm report giving the results of the test and the places of failure. Fire doors, vault-doors, and fire storage-room doors are given similar treatment.

Nearby stands the bed of pain for reputedly fire-resistant safes. After several hours at 2000°F., the safe, if it hasn't exploded because of poor drying, is hauled up three floors, dropped onto a bed of crushed concrete, and put back into the furnace. If the papers inside are scorched or damaged, the safe is rejected. (Burglar-proof safes are tested at another location. They must survive twenty-minutes of the Lab's expert safe-crackers' efforts to

pass inspection. How many safe-crackers can go undetected after twenty minutes of burning and blasting? UL pulls no punches, nor does it spare the noise.)

Upstairs is the sprinkler-head collection. Enshrined in this room are some of the most hopelessly unsafe sprinkler-heads known to man. Some of them, removed from army posts, where they have been painted with military efficiency for decades, probably wouldn't go off if they were set upon with a blowtorch. The actual testing of the heads is done upstairs, in a room full of one-foot-square buckets. Once the head has been set off, all that remains is the measuring of the water level in the buckets to see how well the water has been distributed. The set-off temperature is determined in the room adjacent to the museum.

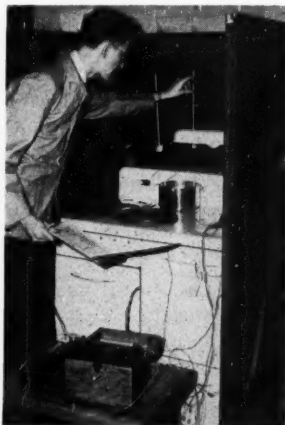
#### Burglar's Nemesis

Then we come to the Burglary Detection department, where the engineers have set up a UL-inspected showcase. For sheer obstinacy, this can't be beaten. It's connected to a warning bell in the nearest police station. If an intruder gets into the room undetected after the alarm has been turned on, and approaches the showcase, the bell rings, if he touches it, the bell rings;

and if he is clever enough to turn it off, the bell rings anyway. No warning is sounded on the premises, and no one has ever fooled the device. Some burglars have been surprised to find the police in the same room with them, just waiting to get evidence. One UL inspector, testing the police as well as the device, was locked up after the police had answered three false alarms in the bank vault he was in.

#### Electrical Testing

The electrical lab, occupying the topmost floors, is the newest of the labs. It was built several years ago to take care of the tremendous number of new appliances which appeared after the last war. There is kept one of the proud possessions of UL—a testing machine known as the Rube Goldberg. It will throw switches, pull chains, and gyrate in all directions, testing 5 different types of switches at once. The work of the electrical lab is not as spectacular as that of the others, but it is still important, and much more continuous. Electrical heater cords are twisted three thousand times



Heat test of a kitchen range.

to see how much they will fray. Electric stoves are placed against a wall in a small black enclosure and set to boiling as much water as possible. Television picture tubes and safety screens are exploded and pounded to see what will happen if the tubes explode. Electric irons are left on for weeks at a stretch, and are dropped on the hard floor

in every conceivable way. Heaters are given every chance to set curtains afire, refrigerators are turned on with no outside air circulation from a dead start. Radio sets are arranged so that the heat from the tubes stays in the set. Motors are run continuously, with thermocouples hanging from them like Spanish moss. If any of these articles develop enough heat to ignite or overheat their surroundings, or short-circuit by faulty construction, or explode, the tests will discover the weak points causing the failure, and the manufacturer gets a report on the performance.

We've skipped many of the testing places, but the tour has shown the tremendous scope of UL activities. Taken as a whole, fully half of the products submitted to UL are defective, and are returned for redesign. The manufacturers could save themselves some money if they were better prepared, because the standards are available to them.

Suppose now that the reader is the maker of a "gimmick" for gas stations consisting of an electric motor, a heating element, and a small lightning rod. He would adopt the following procedure for getting UL to test it: First, a letter to Chicago, New York, or San Francisco, describing the size and function of the device, would get back the standards already developed for the components. It is extremely unlikely that UL would have standards for the device as a whole. Information would also be sent to the reader telling him under what conditions the testing would be carried out, such as cost limit, scope of responsibility of UL, preliminary deposit, number of samples to be sent, and the type of inspection service to be set up at the end of the testing, should it satisfy the requirements. Most large devices are tested on the basis of one sample, but for some smaller ones, several are needed. (In this class are small switches and electric cords.) Should it be too big, and too heavy for shipment to Chicago, where the most elaborate labs are, UL will send engineers to the spot, the expenses to be paid by the submitter. In the case of our hypothetical product, it would be sent to Chicago, where the appropriate departments would test the components. Since

it is to operate in a gas station, the electrical parts would be sent to the explosions lab.

The parts are then tested individually, and if any of them are defective, reports are sent to the maker. Then, when resubmitted and approved, the whole device goes into the thick books of listings of products which have successfully undergone testing in UL's labs, and continue to pass the periodic inspections in the manufacturer's plant. The listings make no claim to be more than listings—they are not recommendations nor do they say how well the products will do their jobs. They only claim that, operated under the conditions prescribed in the Standards, they will behave acceptably.

#### All For Safety's Sake

And UL's operating conditions are nothing to underestimate. The electrical lab operates switches at eight times their designated voltage and twice the current; another lab tests fire extinguishers so that they must be used with the utmost in effectiveness to put out what seem to be pretty stiff standard fires. Safety controls are tripped 100,000 times, and, in general, devices are overloaded, abused, misused, banged, heated, corroded, aged, and submitted to other indignities too numerous to mention. It is obvious that their engineers take as dim a

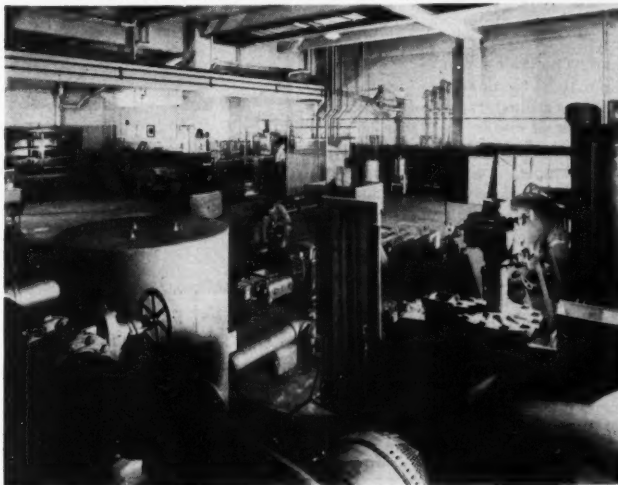
view as possible of the common sense of the public, and this is well justified. Hundreds of examples of gross and seemingly malicious ignorance are turned up every year by the National Safety Council.

All this, remember, is in the name of safety. And safety is the cause of all the assault and the tearing-down. The immense potential fire loss in this country is kept in check by the work of the Underwriters' Laboratories, its stations, inspectors and field representatives, and its inspections of products obtained from both the manufacturers' factories and regular retail stores. The inspections are to make certain that the procedures recommended to the maker at the end of the successful testing are followed to the letter. If they are not, the inspector withholds the right of the product to bear the label of the Underwriters' Laboratories. Most insurance companies in the United States recognize the value of the work and the label, and demand that a device be tested by UL in order to carry insurance.

UL has the field pretty well to itself in the matter of testing the great majority of products which must have safety built-in. There are several other more specialized organizations however, the American Gas Association and the Mine Safety Appliances Company being

(Concluded on page 24)

Underwriter's explosion laboratory. Equipment in foreground is used to test flame arrestors and vent valves for flammable liquid storage tanks.





## New Aircraft Structural Elements

By CONRAD F. NAGEL, JR., B.Chem. '15

*Illustrations courtesy the Author*

In addition to its own weight, an airplane must carry a load consisting of personnel, fuel, power-plant, instruments, cargo, and, in military planes, armament and protective armor. Space for these items is at a terrific premium. So the old (1925) models, with their internal bracings, gave way to monocoque design, in which internal bracing members were reduced to a minimum, thereby providing more space for the load and depending more and more on the "skin" members for structural strength of the plane. Then came the jet planes, with speeds in the supersonic range, calling for much thinner wings. This development places a still greater burden on the "skin." The end is not yet in sight.

The need for greater strength and more compact structures has led to a new concept in aircraft construction: the use of new forms of structural *elements* from which a still more favorable strength-weight ratio may be obtained.

The cardinal factor of strength per unit of weight should be borne in mind. In bridge construction, for example, a simple box girder may consist of perhaps eight angles and four pieces of plate, all riveted together into a girder. The rivet heads and the angles are all excess weight, which could be eliminated if the four plates were joined by welding. This method of fabrication, however, is not yet practical with the aluminum alloys required in aircraft. Then, too, it takes man-hours to make joints, whether riveted or welded, and that factor is of extreme importance in time of war. Now consider, as an example, a brief

discussion of the new one-piece concept of making a structural element—the wing—that has up to now required the assembly of several pieces at a high cost in weight and man-hours.

Let us start with a look at a con-

ventional 1940 wing. Figure 1 shows, in very simplified form, the cross-section of such a wing. In this, as in all illustrations in this article, liberty has been taken in disregarding relative dimensions of the various parts and in omitting

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### THE AUTHOR

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Conrad F. Nagel, Jr., Cornell—A.B. '14, B.Chem. '15, was employed by the Aluminum Company of America, at its New Kensington,



Conrad F. Nagel

Pennsylvania, works, in July, 1915, on technical problems involved in the production of wrought aluminum products.

With the exception of two years during World War I when he served with the Army, Mr. Nagel has been engaged continuously for Alcoa in research and development of aluminum alloy products and manufacturing practices.

He has been Assistant Chief of the Technical Direction Bureau of the Company, and when, in 1928, the name was changed to the "Metallurgical Department, Fabricating Division," he became Chief. He assumed his present position of Chief Metallurgist of Aluminum Company of America, when that office was created in March, 1944. Presently Mr. Nagel supervises the technical activities, mostly of a metallurgical nature, in eighteen of the Company's group of plants.

He is an Associate Fellow of the Institute of the Aeronautical Sciences, a member of the American Society for Metals, the British Institute of Metals, the American Society of Mining and Metallurgical Engineers, the American Ordnance Association, and the National Aeronautical Association. He is also a member of Phi Kappa Sigma and the Alembic Society.

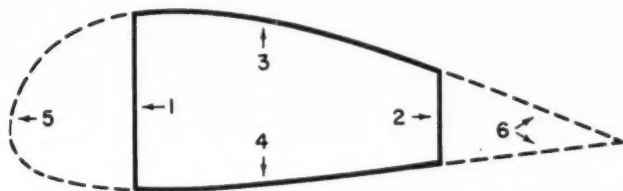


Fig. 1—Simplified Wing Cross-section

details, in order to confine attention to certain major features and make them more easily understandable.

The solid lines, embraced by Items 1, 2, 3 and 4, form a "box girder." This is the "backbone" of the wing; it carries the "structural load." Structures 5 and 6 (dotted lines) merely provide the desired aerodynamical shape to the wing. Item 5 to the leading edge and Item 6 to the trailing edge.

#### Girder Elements

This box girder consists of four major items: the front girder (1), the rear girder (2), the top cover plate (3), and bottom cover plate (4). Let us next consider the front girder (1), shown in further detail in Figure II, merely as a typical example. The essential elements in this girder are the top and bottom spars (Items 6 and 7) and the web (Item 8), which joins them by rivets (Item 9). The bottom spar (Item 7) is produced in one operation by the extrusion method. Note that this particular shape (spar) provides flanges to which the cover plates (Item 4) and leading edge (Item 5—Figure I) can be attached; it also provides a good chunky piece of metal, located near the wing's skin, where it is most needed for structural load-carrying purposes. The shape of the spar enables it to save considerable weight over the former method of assembling several angles and joining by riveting.

Now, let us proceed to another matter. The dimensions shown in Figure II represent the amount of metal required at a certain location in the wing; for example, the "root," where the girder is attached to the fuselage. But as we move from the root toward the tip of the wing, the load decreases; consequently, less metal is required to

carry the load. The present solution is to taper the spar by a machining operation, so as to have it thicker at the root and thinner at the wing tip.

#### Tapered Spars

In making a spar, as represented by Item 7—Figure II, there is first produced, usually by extrusion and in a few instances by rolling, a member having a cross-section of the spar at the root end. Then this piece of metal is machined to a taper from the root to wing tip. Thus, the weight is reduced correspondingly to the load each increment of length of spar is designed to carry.

While Item 7—Figure II implies that the entire wing spar is one single extrusion, even though machined to a taper, it is actually made up of several pieces, with one or more spliced joints. This is because the length of modern wings, in many instances, is so great that extrusion presses of the size now available are not capable of producing a one-piece spar of sufficient length. Splices are therefore necessary; the extra metal, to make those splices, is penalty weight.

The difference in area between the root and tip end cross-sections represents the metal that has been machined away. It represents many pounds of weight saved, and this saving means greater range, higher ceiling or greater load-carrying capacity.

While such a spar, produced by extrusion and then machined to a taper, constitutes a great advance, it has been accomplished at the cost of building special machine tools and by the expenditure of man-hours, both of which are scarce commodities in a national emergency. More recently the thinking has been to produce such spars tapered as they come out of the

extrusion press, and experimentation is actually under way.

#### Extrusion

Perhaps a brief description of the extrusion process is necessary at this point. The extrusion operation may be likened to the squirting of toothpaste out of a collapsible tube. Force is exerted by the fingers to the thin wall tube, which then collapses. The shape of the emerging toothpaste corresponds to the shape of the orifice at the tube's mouth (the die in an extrusion press). In the extrusion of metal, the tube (or cylinder) is not collapsible. On the contrary, it is very strong and rigid. The ingot, while solid, is relatively plastic at the elevated temperatures used in the extrusion process. The ingot is inserted in the cylinder; a ram then presses against it with tremendous pressure, thus causing the metal to flow (extrude) through the die orifice at the other end. When extruding a tube rather than a solid shape, it is necessary to use a mandrel to provide an annular

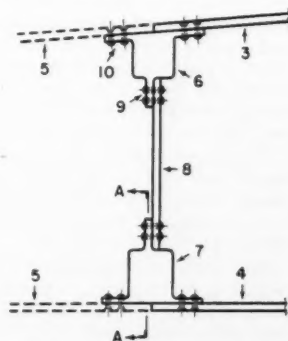


Fig. 2—Wing Girder (Leading Edge)

opening within the die through which the metal can flow. The mandrel is attached to the ram, and must, of course, be long enough to extend through the hollow ingot into the die opening.

It should be mentioned that normally, as extrusion proceeds, the mandrel moves through the die, but the metal being extruded moves ahead at a speed much greater than that of the mandrel. If the mandrel were of uniform diameter, the inside surface of the tube would be badly torn; therefore, the man-

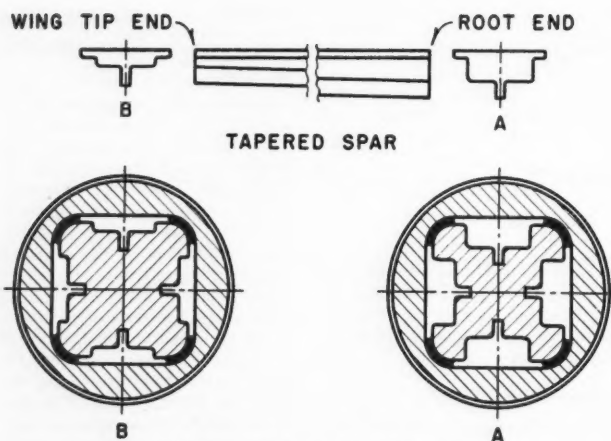


Fig. 3—Producing Tapered Spars by Extrusion

drel is tapered so that the inside surface of the tube will be relieved from contact with the mandrel just beyond the die. This means that the wall thickness of the tube, at the start of extrusion, will be somewhat greater than that at completion of extrusion. Next, it should be pointed out that if a recess is machined in the mandrel, metal will flow into the recess at or near the die, and the resulting tube will possess an inside projection corresponding to the recess in the die.

The present thinking is to produce a spar that is tapered as it emerges from the extrusion press by employing these basic principles. Figure III illustrates the idea.

The outer cross-hatched area represents the die. It has a round-cornered square opening. The mandrel (inner cross-hatched area) has been recessed by machining, as shown in Figure III, to provide the four shapes desired. These are the four white areas. The cross-section of the front end of the mandrel (at start of extrusion) is represented by Sketch A—Figure IV; the rear end by Sketch B. Thus, there will be produced an odd-shaped tubular product, having a cross-section represented by considering the four white areas and the four black circular arc corner segments all as one piece. The entire length of this tubular shape will be tapered in accordance with the taper recessed into the mandrel. Then, this tubular shape is cut longitudinally,

scrapping the black corner sections, thus producing four tapered spars, represented by the top sketch in Figure III.

#### Other Techniques

Reference was previously made to the fact that tapered spars were also produced by rolling. Briefly, the method consists of producing a symmetrical shape by rolling and then sawing longitudinally, on a diagonal line, to produce two tapered spars. This method was used because single spars of longer length could be produced than is possible with existing extrusion equipment. However, the rolling method presents the difficulty that when splitting the rolled shape into two pieces, serious warping may occur, as is also the case when machining extruded spars to a taper.

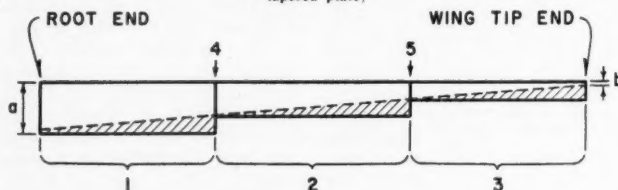
Next, let us consider some problems involved in the cover plates, as represented by Items 3 and 4—Figures I and II, and what is being done about them.

The stresses decrease as one

moves from the root to the wing tip. While plate can be produced of sufficient length to extend from root to tip, the thickness of the plate or sheet would be unnecessarily great at the wing tip and the excess weight would be prohibitive. Consequently, it has been the practice to use one thickness of sheet for a certain number of feet, then change to a thinner sheet, make a splice (joint) and so proceed to the wing tip. The making of each joint adds weight at the joint (rivets, overlap, etc., as already stated) and requires man-hours to make it. To improve this situation, the thought is to produce sheet that is tapered from end to end. Two methods are being employed, both on what should be considered an experimental basis. One is to take plate or sheet of a thickness needed at the thick end and machine away the unneeded metal. This again places a high burden on machine tools and man-hours. The other method is to produce the taper during the plate-rolling operation. This has been perfected to a degree of actual small scale production. The shaded areas in Figure IV depict the weight to be saved merely by having available a tapered plate. This is aside from the savings that result from reducing the number of joints.

The foregoing represents, in simple terms, some of the thinking, the research and development work that is going on. There are still many rather difficult problems to be solved. In this development there is good coordination among the operators, both commercial and military, the manufacturers of the airplane and the producers of the materials from which they are built. All are working in the interest of developing airplanes superior in performance and dependability to those that are now being made.

Fig. 4—Wing Cover Plate (Single hatched areas represent weight saving by use of tapered plate)



# Cathode-ray Oscillography

By DAVID SCHERAGA, EE '54

The cathode-ray tube, since its inception as a mere laboratory curiosity, has grown through the years into a precision device which has been applied in all the fields of engineering, as well as in the home and the research laboratory. Most of us are familiar with its applications to radar and television, but not all appreciate its importance as the heart of one of the most versatile indicating and measuring devices ever conceived—the cathode-ray oscillograph.

The superiority of the cathode-ray tube over other indicating and measuring devices lies in the fact that its indicating element is a practically inertia-free beam of electrons. It will, therefore, respond to the slightest variations in voltage over frequency ranges of millions of cycles per second.

## Cathode-ray Tube

As illustrated in the cutaway-drawing, the modern cathode-ray tube consists of five major components: the glass envelope or bulb, the tube base, the electron-gun assembly, the deflection plate assembly, and the fluorescent screen.

The electron gun provides the

source of electrons and then directs them toward the face of the tube after focusing them into a narrow beam and accelerating this beam so that it strikes the screen of the tube with sufficient energy to cause fluorescence. It is comprised mechanically of a cathode-grid assembly, a preaccelerator electrode, a focusing electrode, and an accelerating electrode.

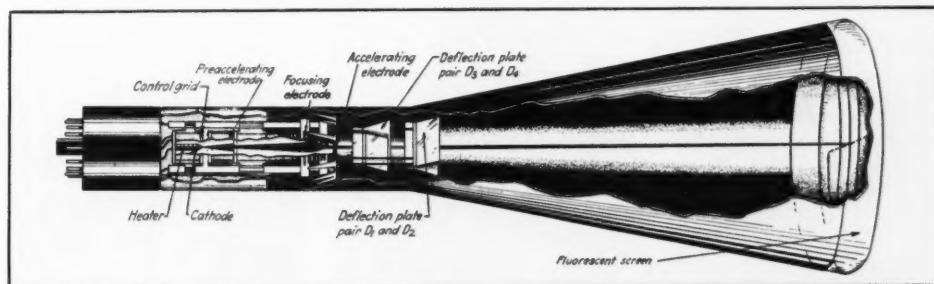
When the cathode is heated to a temperature of about 700°C. thermionic emission takes place from the oxide coating on the outside of the cathode sleeve. The electrons which escape from the cathode are repelled by the walls and end of the more negative grid cylinder. However, a few possess sufficient energy to escape through the aperture in the end of the cylinder and are immediately accelerated by the strong electrostatic field between the grid and preaccelerator electrode. It will be noted that the grid here serves much the same function as in a conventional vacuum tube, that of controlling electron flow through the tube. By varying the negative potential applied to the grid, the number of electrons passing through the aperture can be

regulated, and hence an effective means is provided for controlling the intensity of the beam.

From this point the electron beam diverges until it reaches the region of the focusing and accelerating electrodes, where it is constricted again and accelerated by the surrounding electrostatic fields. Any electrons which diverge too much to be properly focused on the screen are removed from the beam as a result of their failure to pass through the aperture in the disc located in the accelerating electrode.

After the beam has been properly aimed it passes between two pairs of deflection plates which are set mutually perpendicular to each other. By applying the proper potentials to these plates it is possible to bend the beam either vertically or horizontally, thereby enabling the resultant of these two deflecting actions to hit any point on the tube screen.

When the beam strikes the fluorescent screen of the cathode-ray tube its kinetic energy is transformed into luminous energy. The intensity of the light thus produced at each point depends on



Cutaway view of cathode-ray tube showing basic elements of "electron gun".  
Deflection plates move projected beam across screen.

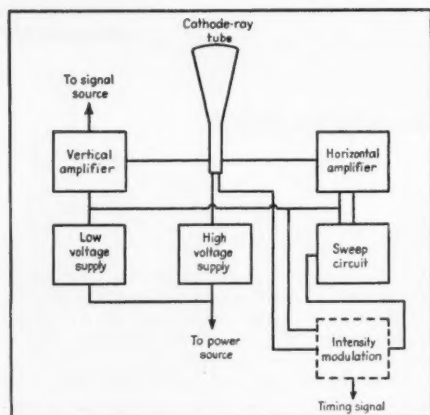
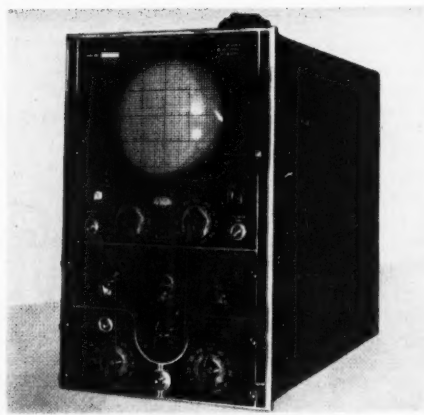


Diagram of components in a cathode-ray oscillograph.



General purpose instrument equipped with 5 n. screen.

the number of electrons striking the screen as well as the chemical and physical properties of the fluorescent coating.

#### Oscillograph Elements

A cathode-ray tube in itself is not a complete indicating device. It requires, among other things, a source of power to supply the proper potentials to the various electrodes in order to produce a spot on the fluorescent screen. Although potentials of at least 1000 volts are required for most tubes, the power requirements are not too severe since the current drain is small. In addition, a source of power must be available to operate the indirectly

heated cathode. As a rule, the power supply of the oscillograph is contained in the instrument.

Unfortunately, the tube itself is a relatively insensitive instrument, and potentials on the order of several hundred volts are necessary for complete deflection of the beam. Since most applications of the oscillograph involve input potentials of much smaller magnitudes, amplifiers are necessary to supply the beam deflection voltages to the tube. As can be seen in the block diagram of the cathode-ray oscillograph, an amplifier is required for both the horizontal and vertical axes of the tube. It is desirable that both these amplifiers have similar

phase characteristics in order to facilitate comparison of frequency and phase relationships between two different a-c signals by applying each signal to a set of deflection plates. Another important requirement of a deflection amplifier is that its output voltage possess good linearity in order that the accuracy of the oscillograph as a measuring instrument is not impaired.

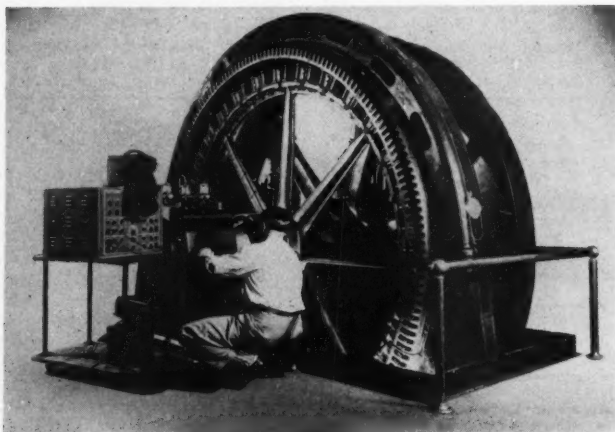
The oscillograph is fundamentally an instrument for plotting a visual curve (electrical waveform) on a fluorescent screen. The curve is usually plotted having coordinates of the orthogonal or Cartesian type. Thus, in conventional oscillographs the horizontal axis of the screen represents time, since most phenomena are functions of time, while the unknown variable voltage is plotted along the vertical axis. Essentially then, we have an instrument on which the instantaneous values of any quantity which can be converted into a suitable electric signal may be plotted against a time reference.

#### Time-Bases

The time-base just referred to is produced in the oscillograph by the sweep oscillator or time-base generator. It is usually in the form of a sawtooth voltage, but can also be a sinusoidal, circular, or spiral function, or any other shape that may be desirable for particular applications.

One of the important features of  
(Continued on page 22)

Checking vibration in the bearing of an alternator using dual-beam oscillograph. Special camera records oscillograms of vibration patterns.





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# PROMINENT ENGINEERS

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## Loren F. Kahle, ME

A man who has earned, perhaps several times over, the designation "Prominent Engineer" is Loren F. Kahle. His impressive scholastic record has led him to the Dean's List on several occasions, and to the position of eighth in his class of M.E.'s.

Loren, however, has never allowed his studies to interfere with his education, and has participated in a multitude of worthwhile activities. Athletically, his interests have included Varsity Swimming; President of Aquarius, the swimming honorary group; Manager of Freshman Baseball; and membership in the Varsity Managers Club.

Kappa Tau Chi has elected him to positions of Treasurer and Vice-President, and in 1949 presented him with its Scholastic Achievement Award. He has earned membership in Pi Tau Sigma and is Vice-President of Tau Beta Pi. Other positions he holds currently are President of the Engineering Council and Vice-Chairman of ASME.

Loren can claim an international

Loren



background; he was born in Mexico and moved to Venezuela at the age of five when the oil business took the family to that country. He came to the United States in time to begin high school at Tulsa, Oklahoma. Loren isn't sure exactly why he came to Cornell for his work in engineering, except for the school's reputation and opportunities in that field.

Although the future is somewhat uncertain, Loren has decided against graduate study and hopes to enter industrial work, perhaps as related to the oil industry.

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## Albert Bishop, EE

For years, one of the favorite gripes of Cornell engineers has been the lack of sufficient spare time to participate in extra-curricular activities. Yet, there will always remain a few, who seem to have the time to become active in campus affairs and still maintain high scholastic standards. Albert Bishop is one of these.

Al isn't quite sure where he got his start in engineering. He had always shown an interest and aptitude for studies of an engineering nature and the fact that his father is an E.E. probably influenced him no little.

He got off to a flying start by making Dean's List his first term here, a feat which he has accomplished every term since. In addition he made the Freshman Crew, desiring to continue the rowing he did in high school. He has been on the crew for four years and received his varsity letter last year. While a conscientious and serious student, he somehow or other always manages to have time left over for activities outside of the E.E. school. These activities have included work with the Student Council book ex-

change and the Inter-Fraternity Council executive committee in addition to his duties as president of Sigma Pi.

His high scholastic standing has helped him in more ways than one. Aside from having been awarded a



Al

John McMullen Undergraduate Scholarship for eight consecutive terms, Al has been honored by acceptance into Eta Kappa Nu and Tau Beta Pi. He is now vice-president and secretary, respectively, of these two societies. Al also belongs to the Cornell branch of the AIEE of which he was student treasurer last year.

Deciding that practical experience in industry would be invaluable to him later on, he spent this past summer with the Philco Corporation engaged in research on color television. However, Al's main interests lie more along the line of administrative work, one of the reasons being that he enjoys working with people. At present he is enrolled in the Industrial Electronics option, but has no definite plans for his future field of specialization.

# Cornell Society of Engineers

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George T. Minasian

*"The objects of this Society are to promote the welfare of the College of Engineering at Cornell University, its graduates and former students and to establish closer relationship between the college and the alumni."*

## *President's Message*

I sometimes think we Americans are a race of sloganers. Whether we are selling toothpaste, cigarettes, a political candidate, a way of life or a religion, we are always looking for the "cute" phrase, the catchy twist. In fact sometimes the slogan comes first and the product to fit it comes afterwards. Is this bad? No, I don't think so and sometimes the phrase, slogan, motto or whatever you may call it can have quite an influence on our lives.

Those of us who were in Engineering at Cornell prior to the twenties—probably all have fond memories of particular members of the University Staff of that day. In my mind Dean A. W. Smith of Sibley, affectionately known as Uncle Pete, is perhaps the "most unforgettable character." A fine engineer, a famous Cornell oarsman—but particularly a great friendly spirit.

It was natural when meeting him on the campus to fall in with him and walk along without feeling the least self-conscious about being seen with the big boss. Conversation came easily, whether about the view across the valley, the latest ball game, or the new co-ed in Sibley.

Our first introduction to "Uncle Pete" as Freshmen was his "Engineering Principles"—a must for all first year men. "Nature's Pumping Engine" and "Nature's Fuel Cycle" and bits of

simple elemental philosophy that really "set the stage" although I doubt we appreciated it fully at the time.

The last time I can remember "Uncle Pete" talking to us as a group was near the end of our Cornell course and during the hectic days of the first World War.

And this is where the slogan came in. As I remember it the subject of the talk was a sort of preparation for the difficulties a young engineering graduate meets in facing the tough business world. Probably nothing much new and I can't remember being particularly inspired until he reached the "leave one thought with you" stage.

That thought "Go as far as you can see and then see how far you can go." I have never forgotten. It has the strangest way of continually popping up in my mind and yet I have never heard anyone else quote it.

Whenever a job presents itself and I don't know just where to start or what to do about it Uncle Pete's phrase pops up and I start setting down what I do know—and somehow the way opens up. But why grow sentimental about it. To be practical—doggone it—it works. Try it and see for yourself.

GEORGE T. MINASIAN

THE CORNELL ENGINEER

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# News of the College

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## New Research Project

The Salvatore Giordano Foundation, Inc., of Maspeth, New York, has granted a fund of \$5,000 a year for the next five years to the School of Mechanical Engineering for research studies in "Extended Surface Heat Exchangers." The project will attempt to determine the optimum extent of secondary surface to obtain maximum heat transfer per pound of heat exchanger weight in finned surface exchangers with air as the fluid on the secondary surface.

The project will be carried out by Professor Shepherd and other members of the staff under the direction of Professor Charles O. Mackey, Head of the Department of Heat Power. Though still in the preliminary stages of literature research, the project will have its experimental phase conducted in the Heat Power Laboratory behind Sibley.

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## Pioneer Television Transmitter

One of the television industry's pioneer transmitters has been installed recently in the School of Electrical Engineering. A gift of the Philco Corporation, the equipment was one of the important links in the development of the present all-electronic television system. It was built in 1940 as the culmination of 11 years of research by the company and was the second in the country to be operated for commercial television broadcasting.

Equipped for both amplitude modulation and frequency modulation picture transmission, it is especially useful in teaching student engineers the fundamentals of television.

Larry E. Gubb, B.S. '16, director and former chairman of the board of directors of Philco Corporation, was instrumental in the gift by Philco, which enjoys a close rela-

tionship with Cornell in the cooperative engineering program.

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## Freshman Orientation Program

As a constructive step toward alleviating the difficulties of freshmen in adjusting to the tempo of college study, the College of Engineering is embarking for the first time on an extensive orientation program incorporating the latest techniques of psychological testing and verbal education.

Dean Hollister stated that the purpose of the program was twofold: (1) to give the freshman a better idea of what is involved in engineering and his particular branch and (2) to aid the new student in acquiring the study techniques necessary for successful performance at college. The Graduate School of Education and the Department of Psychology are assisting by making various studies in the measurement of actual intellectual development and instituting remedial reading programs. Experimental evidence shows that if reading habits can be improved, grades in certain types of academic work can also be improved.

The correlation between the verbal comprehension scores and the cumulative averages of last year's freshman class will be studied. The senior class will also be tested for verbal comprehension to ascertain to what degree that aptitude is necessary for a successful college career as measured by their academic records. Secondary effects of the remedial reading program, it is hoped, will be increased outside cultural enjoyment by engineers and increased leisure time for the traditionally hard-pressed engineers.

The Dean pointed out that the freshman median for Scholastic Aptitude Test scores in mathematics is in the top 11% bracket of all national scores. With such high po-

tential engineering material, there is no reason for freshmen failing to make the grade. Dean Hollister expressed the ardent hope that the students would meet the College halfway in its efforts to insure the successful completion of their engineering training at Cornell.

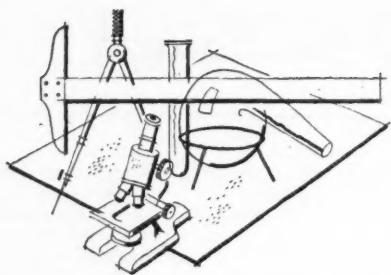
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## Faculty News

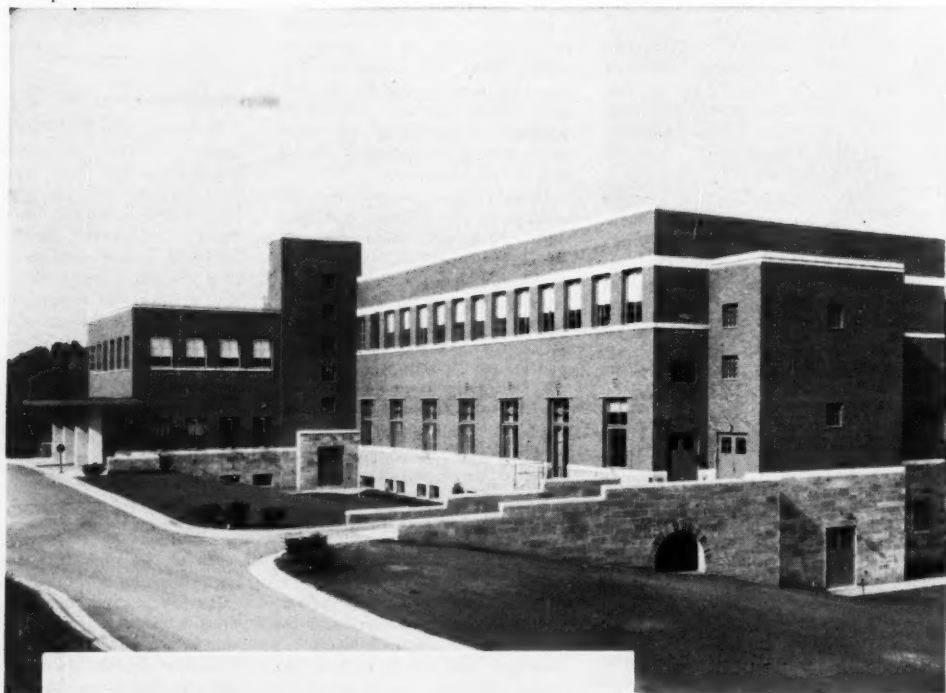
Professor John M. Wild of the Graduate School of Aeronautical Engineering has been appointed chief engineer for a big propulsion wind tunnel at the Air Force's new Arnold Engineering Development Center at Tallahoma, Tenn. He has been granted leave by the University to supervise design and construction of the tunnel, which will permit the testing of full-scale supersonic jet engines. Since coming to Cornell in 1946 from a position as supervisor of aerodynamics for Northrop Aircraft, Professor Wild has been closely connected with preliminary studies on the tunnel project.

The following promotions were made in the College of Engineering: Benjamin K. Hough, full professorship in civil engineering, Andrew S. Schultz, Jr., full professorship in mechanical engineering, and Hamilton Horth Mabie, associate professorship in mechanical engineering.

Donald P. Eckman, teaching fellow in the Department of Engineering Mechanics, is the author of a new book, "Industrial Instrumentation," published by John Wiley & Sons. For the past four years, the author has also been a consulting engineer for the Conoflow Corporation in Philadelphia. His new book, an introduction to the science of measurement, stresses the principles and methods employed in industrial processing and manufacturing.



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The new home of the Westinghouse Educational Center where new employees from engineering colleges receive an orientation and training program to help them find the kind of work they like to do and are likely to do best. Hundreds of experienced professional people help carry out this program. A Graduate Study Program is also made available through which advanced degrees may be obtained.

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ern class rooms equipped for visual education . . . a large auditorium with complete stage and projection room facilities . . . and a large, comfortable library and study hall. Here an intensive course of study is given by engineers and scientists who are top-ranking men in their fields.

These same facilities are also adequate to take care of the needs of post-training-course employees who are participating in the Graduate Study Program and the many other educational activities of Westinghouse.

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In planning the new Educational Center, careful thought was given to recreation. A spacious lounge, hobby and game rooms, a billiard room, facilities for indoor and outdoor sports along with a convenient cafeteria—all contribute to a well-rounded program.



## Alumni News

**Ernest M. Gilbert, M.E. '95, '96**, has been elected a Fellow of the American Society of Mechanical Engineers. He is chairman of the board and chief engineer of Gilbert Associates, Inc., 412 Washington Street, Reading 7, Pa.

**William G. Seyfang, M.E. '09**, managing engineer for the Buffalo Board of Education, is a member of the American Society of Mechanical Engineers, the American Society of Civil Engineers, the American Society of Heating and Ventilating Engineers, and Professional Engineers of New York State. His address in Buffalo is 116 Dorchester Road.

**A. Clinton Decker, C.E. '09**, prominent sanitary engineer who died May 22, bequeathed sixty thousand dollars to be held as a trust fund, "the income therefrom to be



A. Clinton Decker

used for creating one or more scholarships in the College of Engineering." He was for many years keenly interested in all developments at Cornell, and his desire to

help young men get the education in engineering from Cornell which he so highly prized led him to create the scholarships. The late Mr. Decker was for many years associated with various subsidiaries of the United States Steel Corporation, and was highly honored in the national societies of his profession. He was a national director of the American Water Works Association, chairman and secretary of the Sanitary Engineering Section of the ASCE, a Fellow of the American Public Health Association, president of the Engineers Club of Birmingham and chairman of the Alabama section of the ASCE. He was also a member of the Cornell Society of Engineers, the Exchange Club of Birmingham, Alabama, State Chamber of Commerce and the Alabama Motorists Association.

**Arthur B. Holmes, BArch. '11**, is executive director of the New Jersey Chapter, American Institute of Architects, and the New Jersey Society of Architects. His address is 353 South Center Street, Orange, N. J.

**Harold R. Sleeper, BArch '15**, is the new president of the Architectural League of New York. Mr. Sleeper is also vice-president of the New York Building Congress and a former president of the New York chapter of the American Institute of Architects. His office is at West Forty-fourth Street, New York City, 18.

**Spencer Brownell, Jr., B.M.E. '25**, has been appointed manager of the Patent Division of the Du Pont Company's Legal Department. Mr. Brownell received his law degree in 1931 from Georgetown University. For the past five years he has been assistant to the president of Du Pont.

**Moorhead Wright, Jr., E.E. '27**, manager of employee and community relations at Hotpoint, Inc., Chicago, Ill., has received a Charles A. Coffin Award, foremost national



George R. McMullen

industrial honor, for "work of outstanding merit during 1949." Mr. Wright administers the "Key Men of Hotpoint," a group that includes about 250 employees representing supervisory personnel. The organization is regarded as one of the outstanding employee-management groups in American industry.

**Edward B. Snyder, BChem. '34**, has resigned as plant technical director of Kimble Glass Division of Owens-Illinois Glass Co. to become manager of Bentley-Harris Manufacturing Co., manufacturers of electrical insulation, in Conshohocken, Pa. He lives on Brooke Road, Wayne, Pa.

**George R. McMullen, B.M.E. '39**, has been appointed manager of automotive and aircraft sales in Owens-Corning Fiberglass Corp. He has been sales representative in the Detroit office since he joined the company in 1946.

**THE CORNELL ENGINEER**



## "Snug Harbor"

JUST AS SNUG HARBORS offer ships protection from stormy seas, there are protective coatings today that guard them against sleet, snow, salt spray—and other damaging forces.

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## Techni-Briefs

### Photo-Plastic

A new plastic that can be made into scale models of machine parts and tools, is now providing "internal vision" for engineers in military, university and industrial laboratories here and abroad. First announced as a laboratory creation more than a year ago, the new photo-plastic is aiding researchers in gun factories, airplane engine plants, arsenals, naval laboratories, and universities in the design of stronger machinery and equipment. The three dimensional scale models cut from the plastic enable scientists to get a portrait in color of the strains encountered in tools, machine parts, and other objects. The plastic can be cast in cylindrical chunks 8 inches in diameter and 36 inches in length, whereas previous "photo-plastics" were limited to flat pieces not more than an inch and a quarter in thickness. One of the major applications of the new material is in the design of breech

blocks for big guns. To understand the terrific stresses these parts undergo during fire of the gun, an exact three-dimensional model of the block has been built and 'loaded' to simulate stress. When frozen into the material and then viewed through special polarized light, the stress pattern appears as a series of vari-colored lines that tell the scientist where the major stresses are located, in which direction they are acting, and just how great they are.

### New Supercharger

A turbosupercharger which will enable piston powered commercial airliners to fly non-stop from Chicago to London with heavy payloads has been developed by aircraft research engineers. Aerodynamic design improvements in the turbo and advanced engine designs which permit operation of the turbosupercharger under higher

exhaust pressures than previously possible have boosted takeoff power by 32 per cent and reduced fuel consumption more than 20 per cent. The new turbosupercharger eliminates the conventional geared turbo unit operating off the engine shaft. There are no mechanical connections between engine and turbo. Development of a direct cylinder fuel injection system for the new turbo unit eliminated the major need for a geared supercharger which is used to insure uniform fuel distribution to the cylinders. Elimination of the geared supercharger not only saves up to 500 h.p., previously drawn from the piston engine, but also makes possible a more efficient method of cooling the combustion air entering the cylinders. With the new power plants, non-stop trans-Atlantic flights can be made at faster speeds and with heavier payloads than is now possible by airliners making two stops enroute.

Fig. 9—These germicidal Sterilamps, installed in the main duct of a theater's air-conditioning system, kill about 95 per cent of all air-borne bacteria by emitting ultraviolet radiations.

—Courtesy Westinghouse



### Vidicon Television

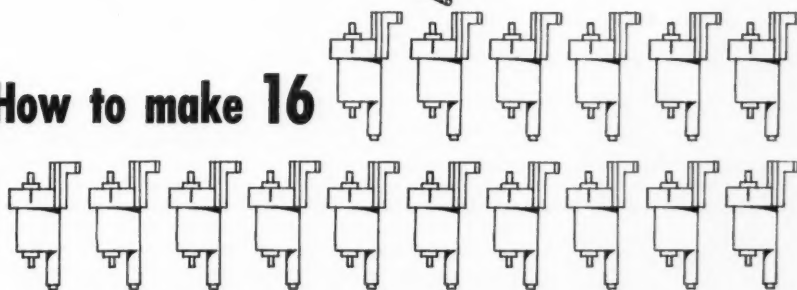
A new television system that extends human sight far beyond normal limits for benefits to science, industry and education has been developed. Described as the smallest and simplest system yet devised for non-broadcast, industrial television operations, the new system is based on a small, sensitive pickup tube known as the Vidicon. The system consists of but two units—a television camera approximating the size of a personal 16 millimeter movie camera and a master control monitor that can be carried as easily as a suitcase.

The Vidicon tube, less than a tenth the size of the conventional orthicon, is able to transmit black-and-white pictures at normal lighting levels and to attain a resolution of more than 500 lines. The system can be adapted to produce pictures

(Continued on page 26)

# Newsworthy Notes for Engineers

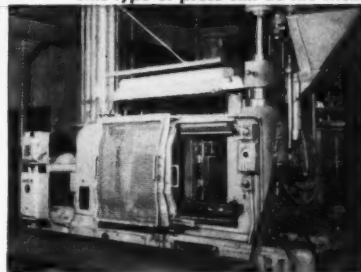
## How to make 16



at the cost of 1...



*This type of press can do the trick.*



These odd looking little gadgets, called "pawls," go into high speed telephone dials used by Bell System operators.

Until recently, pawls (like the black one) were made of molded rubber with a steel pin for the shaft. They did their job well and lasted a long time. But Western Electric engineers decided to try to make them at a lower shop cost.

The engineers came up with an idea—mold the pawl, pin and all—in one piece of nylon. They made some samples—tested them thoroughly—found the nylon pawls would last as long and perhaps even longer in service. Bell Telephone Laboratories tested them—and approved. So Western Electric engineers tackled the production problems—designed new machinery for molding pawls in one piece. It wasn't

easy—because all dimensions had to be controlled with extreme accuracy. But today the new nylon pawls are being made in quantities—*sixteen of them for the cost of one of the old type!*

This story of cost reduction—and there are scores of others like it—shows one way that Western Electric engineers help to keep down the cost of equipment produced for Bell Telephone companies and, therefore, the cost of service to telephone users.

## Western Electric

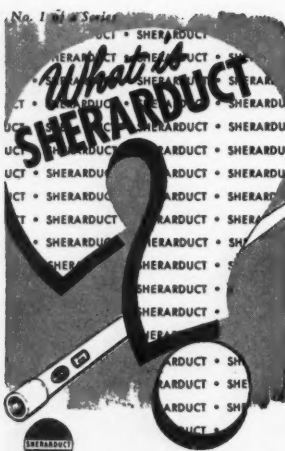
A UNIT OF THE BELL



SYSTEM SINCE 1882

*Engineering problems are many and varied at Western Electric, where manufacturing telephone equipment for the Bell System is the primary job. Engineers of many kinds—electrical, mechanical,*

*industrial, chemical, metallurgical—are constantly working to devise and improve machines and processes for production of highest quality communications equipment.*



Pipe, itself, does not have all the properties required of a true electrical conduit. But National Electric processes a *special* steel pipe into a real quality conduit—Sherarduct.

### Here's how:

- 1 Special high-grade steel is Spellerized—a kneading process that produces fine, even-textured steel.
- 2 The Spellerized steel is rolled into pipe, put through the Scale-Free process and pickled.
- 3 This specially treated pipe is Sherardized—an exclusive process of galvanizing that applies zinc to metal under heat. This affords permanent protection against rust.
- 4 A smooth "Sera-Solution" enamel is baked into the pores to give acid-resistant surfaces.

Then—and only then—do you have Sherarduct, a true conduit . . . long lasting, easily fished, rust proof, easily bent, strong, easy to handle.

Sherarduct is only one of the many outstanding products made by National Electric—a reliable source of supply for your future electrical needs.



## Cathode-Ray Oscillography

(Continued from page 12)

this sweep oscillator is that its frequency of oscillation is synchronized with the frequency of the unknown signal so that in cases of recurrent phenomena the beam will always begin its travel across the face of the tube at the same position on the waveform being displayed. This results in what is known as a "locked in" pattern.

As mentioned before time-bases other than linear functions may also be employed. For applications involving rotating machinery a sinusoidal time-base is desirable. It is obtained either from an external sinusoidal oscillator or from a small generator mounted on the rotating shaft so that the frequency will correspond to the speed of the shaft. The circular time-base is also useful in rotary motion studies since the quantity being investigated can be plotted as a function of angular position.

In addition to the high-voltage power supply necessary to operate the various electrodes of the tube a low-voltage power supply is also required for the amplifiers, the sweep circuit and the positioning circuits. The requirements of this power supply are much more stringent than those of the high-voltage power supply since small irregularities in the power source must be eliminated to prevent disturbances in the position of the beam and the size of the pattern. In addition, care must be taken to shield the cathode-ray tube properly in order that the electron beam is not affected by any magnetic field emanating from the power supply. The magnetic field of the earth itself is sufficient to cause at least a half inch of deflection in the larger tubes.

### Practical Applications

The practical applications of the cathode-ray oscillograph are many and varied. Besides its use as an instrument for the study and testing of almost every electrical device imaginable, the oscillograph has also been applied to fields other than electricity. For example, it may be used to study vibrations in machinery, phenomena within the internal combustion engine, or properties of metals. It has proved to be invaluable

in the field of medicine, where, among other things, it is being used for brain surgery and research. In fact, the fundamental limitation upon the use of the cathode-ray oscillograph in the study of any phenomenon, whether it be electrical, mechanical, biological, optical or even chemical is the ability to convert the phenomenon into a suitable electric potential. To help accomplish this we make use of a device called a transducer.

There are numerous types of transducers now being used, each of which is suitable for a particular kind of problem. This does not mean to say, however, that only one type of transducer may be applied to one particular problem. Indeed, the choice of transducer depends entirely upon the existing physical conditions and the ingenuity of those making the investigation. Some of the more general classes of transducers are vibration pickups, piezo-electric pickups, photocells, microphones, pressure pickups and variable impedances. Of course, any device which will convert a phenomenon into an electric potential may be used. To date investigators have not encountered any such phenomenon which is not capable of being converted into electrical form.

### Transducers

Briefly outlined, a good transducer should possess the following characteristics: it should be a small self-contained unit; its amplitude range should be such that it will not be exceeded by the phenomena under test; its output should be sufficiently high so that it may be applied directly to the oscillograph without the necessity of preamplifiers and it should have a frequency, phase, and amplitude response sufficient to display the phenomenon under study without distortion. In addition, a transducer should be light in weight and designed so as to be capable of continuous operation without changing its calibration and without deterioration. Photocells and Rochelle salt crystals are not, for example, capable of long operation under high temperatures and most gas-filled photocells are subject to fatigue.

While most ordinary problems  
(Concluded on page 28)

THE CORNELL ENGINEER



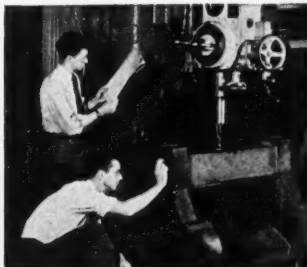
# THE DU PONT DIGEST

## Engineers At Work

AT DU PONT THEY FIGURE IMPORTANTLY IN MANY FIELDS



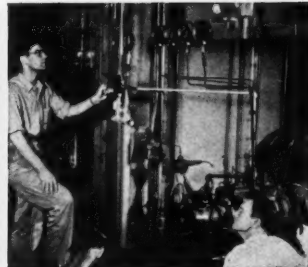
Studying product development in a rotary dryer are: H. J. Kamack, B.S. in Ch.E., Georgia Institute of Technology, 1941; and F. A. Gluckert, B.S. in Ch.E., Penn State, 1940.



Checking component for machine used to finish rolls to high degree of precision: Donald F. Miller, B.S. in M.E., Lehigh, 1950; and Albert W. G. Ervine, M.S. in M.E., Michigan, 1950.



R. E. Sugg, B.S. in M.E., George Washington University, 1948, doing mechanical research to improve machine design. His optical-slit microscope measures surface scratches as fine as 20 millionths of an inch.



R. L. Stearns, B.S. in Ch.E., Yale, 1949; and H. Peterson, B.S. in Ch.E., Northeastern University, 1942, checking a multi-stage carbon-monoxide compressor used for making methanol.

**B**ECAUSE Du Pont is a chemical company, you might expect most of its technical men to be chemists.

Actually, there are more engineers than chemists at Du Pont. In each of the ten manufacturing departments there is important work for men trained in chemical, mechanical, electrical, metallurgical and other branches of engineering.

These departments operate much as independent units with their own research, development, production and sales staffs. In their respective fields, they do fundamental and applied research on both processes and products. Sometimes engineers participate in the early stages of a project. More often, however, they enter the picture when the project has moved to the point where commercial production is considered. They see it through the pilot plant and semi-works stages and assemble data

necessary for the full-scale plant.

Even after manufacturing has begun, development work is continued to standardize and improve the process. Normally, engineers whose main interest is production and plant operation take over when the works stage is reached.

Engineers on the technical sales staffs help maintain contact between Du Pont and its customers. They present data on new products and guide customers in process development and similar problems. They also use their technical knowledge in making surveys of possible markets for the Company's products.

In addition to the manufacturing groups, the Du Pont Engineering Department—a central staff organization—requires engineers with many types of training. This Department carries on its own program of fundamental and applied research. It also

makes site investigations, lays out and designs new plants and laboratories for the manufacturing departments. It serves them in research on process development, on materials of construction and on methods of measurement and control.

Yes, engineers figure importantly at Du Pont. Through their teamwork with chemists, physicists and other trained personnel, the Du Pont Company produces its "Better Things for Better Living...through Chemistry."



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If no other Type R feature were listed, here's one that says: **Specify Morris**. But there's even a bigger story. Ask for further information on this outstanding slurry pump, servicing scores of material handling applications.

### OTHER MORRIS TYPE R FEATURES

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**Specify MORRIS Type "R" SLURRY PUMP**

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*Centrifugal Pumps*

## Watchdog of the Nation

(Continued from page 7)

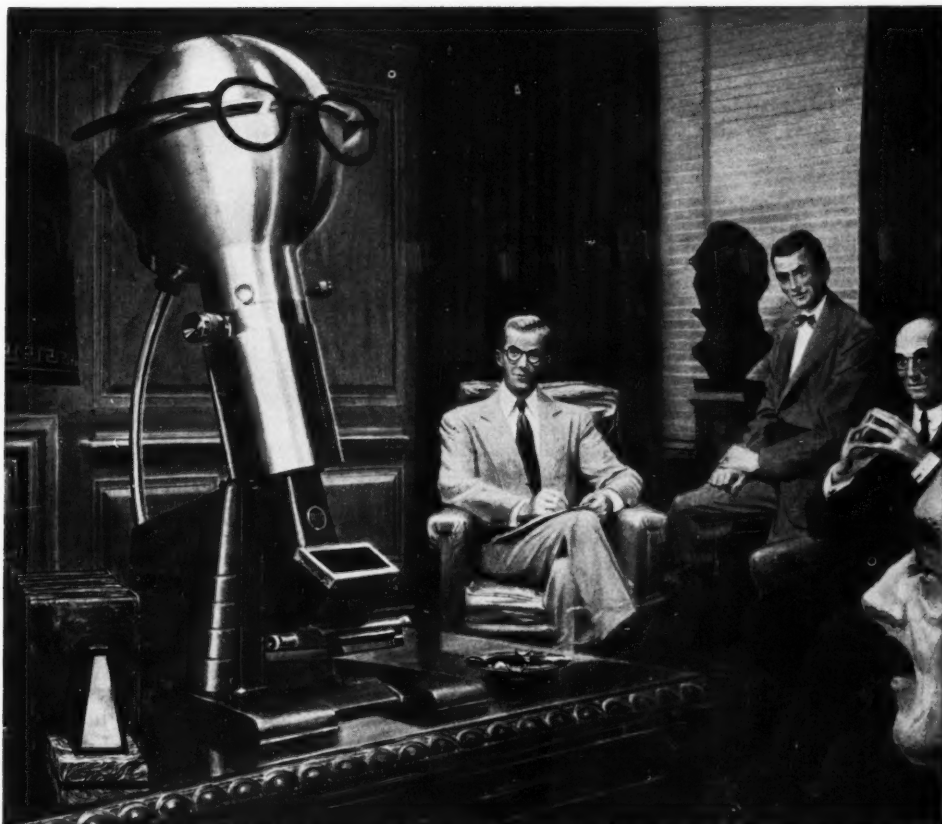
two of the most important. Underwriters' Laboratories of Canada was formed by the corporation in that country to carry on similar work. Its charter was granted by the Dominion. It is noteworthy that not many industries have their own testing facilities. The public is likely to be wary of self-awarded certificates. The hundreds of millions of labels affixed every year to UL-inspected articles are widely recognized and highly respected, and are carried on everything from safes, lightning rods and electric signs to radios, fire extinguishers and oil burners. In all, over 5,000 manufacturers submit their products for testing, and it is the fees paid by them which support all of the UL activities.

### Safety Hints

Although it does not deal directly with the public, UL must appeal to everyone to observe a few safety rules. For instance, if your fuse blows out, it's for the very good reason that your house lines were carrying too much current. A penny in the fuse box will give no protection at all—and will be a threat to your safety. A radio in the bathroom is all right, but if it falls into the bathtub, electrocution is certain. Never allow anyone to use electric appliances without an appreciation of the dangers, and use a chemical fire extinguisher on an electrical fire. Never use inflammable solvents near flames or indoors. The list is long—but it's the price to be paid for living in a civilization so attuned to modern technology.

Underwriters' Laboratories' engineers, prowling around their labs and torture-chambers, probing with their ever-present thermocouples, are reassuring evidence that, should you ever be caught in a burning building, the fire-walls will hold back the flames until you can crash some inspected panic bolts, and get to that *safe* elevator. You needn't worry about your papers in the fire-resistant safe. If it's UL inspected, all will be well until the smoke-eaters douse the blaze with their inspected hoses. They'll have to use unlabeled water, though.

**THE CORNELL ENGINEER**



Portable electron microscope, developed by RCA, widens research in universities, industries, hospitals.

## *The new instructor gets a hearty welcome*

You've read, in both newspapers and magazines, about the powerful electron microscope. Now this amazing "instructor" of scientists, physicians, and engineers becomes even more useful—in more research fields.

Through principles uncovered at RCA Laboratories, RCA engineers have developed a compact "table model" electron microscope, at a price which makes it practical for use in an increased number of universities, industries, hospitals, clinics. So simplified is the new instrument

that even a high school student or unskilled laboratory technician can quickly learn to use it!

Magnifications of 6000 times can be obtained directly in RCA's portable electron microscope—four times that of ordinary light microscopes—and photography lifts this to 30,000! A new "instructor," yes—and one that gets a very hearty welcome.

\* \* \*

See the latest wonders of radio, television and electronics in action at RCA Exhibition Hall, 36 West 49th Street, New York. Admission is free. Radio Corporation of America, RCA Building, Radio City, New York 20, New York.


### Continue your education with pay—at RCA

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- Development and design of radio receivers (including broadcast, short wave and FM circuits, television, and phonograph combinations).
  - Advanced development and design of AM and FM broadcast transmitters, R-F induction heating, mobile communications equipment, relay systems.
  - Design of component parts such as coils, loudspeakers, capacitors.
  - Development and design of new recording and producing methods.
  - Design of receiving, power, cathode ray, gas and photo tubes.
- Write today to National Recruiting Division, RCA Victor, Camden, New Jersey. Also many opportunities for Mechanical and Chemical Engineers and Physicists.



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**YOU CAN AFFORD CASTELL—** because it outlasts other pencils, hence is more economical. In addition, you get the personal satisfaction of superior craftsmanship that only CASTELL gives. Unlike ordinary pencils, CASTELL sharpens to a needlepoint without breaking.

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## Techni-Briefs

(Continued from page 20)

in natural colors. The camera tube contains only an electron gun and a target, as contrasted with gun, two-sided target, image section and electron multipliers of the image orthicon tube. Ordinary 16 mm motion picture lenses will work satisfactorily with the Vidicon, which is only one inch in diameter and six inches long.

A wide range of industrial, scientific and educational applications present possibilities for utilizing the new video system. Details of dangerous operations and experiments, inspection of cylinder interiors and well casings, projection of rare surgical operations—all are made possible by the newest TV development.

### Pulverization Technique

Rapid, effective pulverization of previously hard or impossible-to-grind materials now can be accomplished by a liquid nitrogen impact

pulverization process. The new technique uses liquid nitrogen, in spray form, to cool the material rapidly to a point of maximum fragility, and thereby reduce the amount of energy required for its fracture. In operation, liquid nitrogen from a portable source is injected into a special heat exchanger installed between the feed hopper and a high speed stainless steel pulverizing mill. The fine liquid nitrogen spray plays on the material passing to the mill, cooling it by direct-contact heat transfer and simple evaporation. Cold gaseous nitrogen which is evolved, precools the material in the feed hopper and effectively excludes room air which could raise the temperature of the system.

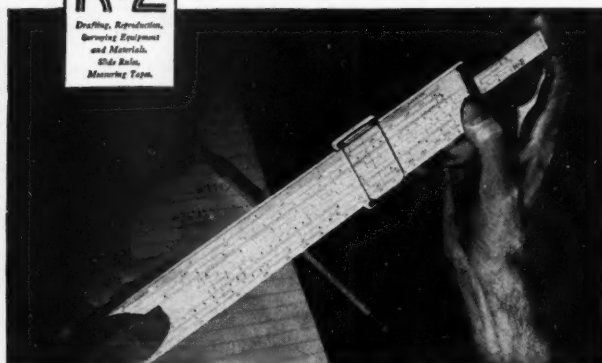
### Neutron Detector

The presence of neutrons which are emitted by many radioactive materials and which are dangerous to the health of atomic laboratory workers in large doses, can now be

(Concluded on page 28)

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Engineering leaders for the last 81 years have made K & E instruments, drafting equipment and materials their partners in creating the great technical achievements of America. So nearly universal is the reliance on K & E products, it is self-evident that every major engineering project has been completed with the help of K & E.



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Another page for

## YOUR BEARING NOTEBOOK



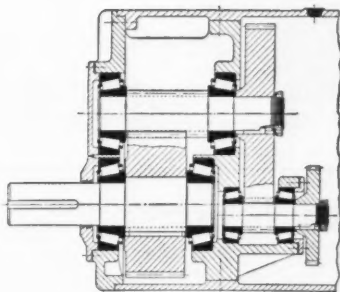
### How to help a gearmotor take care of its teeth

To minimize wear on the teeth and to insure smooth, quiet operation, reduction gears in motors like this must be held in perfect mesh, no matter what the load. That's one reason why engineers mount the gear shafts on Timken® tapered roller bearings. Timken bearings hold the shafts in accurate alignment. Gears are kept perfectly positioned, with each tooth meshing smoothly and carrying its full share of the load.

---

### Gears mesh smoothly, wear longer, with shafts on TIMKEN® bearings

Here is a typical gear-case countershaft showing a common method of mounting Timken bearings. Due to the line contact between the rolls and races, Timken bearings give the shaft maximum support. There's less chance of deflection under load. The tapered bearing design takes both radial and thrust loads in any combination. End-movement of the shaft is kept to a minimum. Gears wear longer—work better.



**TIMKEN**  
TRADE-MARK REG. U. S. PAT. OFF.  
**TAPERED ROLLER BEARINGS**

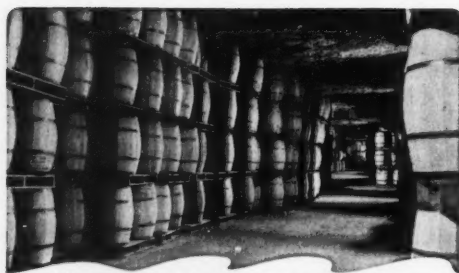
### Want to learn more about bearings?

Some of the important engineering problems you'll face after graduation will involve bearing applications. If you'd like to learn more about Timken bearings and how engineers use them, write today to The Timken Roller Bearing Company, Canton 6, Ohio. And don't forget to clip this page for future reference.

---

NOT JUST A BALL ○ NOT JUST A ROLLER ◯ THE TIMKEN TAPERED ROLLER BEARING TAKES RADIAL ⊙ AND THRUST ⊖ LOADS OR ANY COMBINATION ⊕





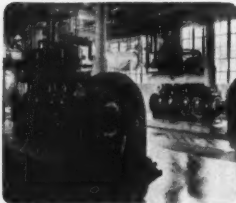
### Gigantic Underground Storage Uses Frick Refrigeration

Originally a limestone quarry, the Natural Cooler Storage of the U. S. Dept. of Agriculture near Atchison, Kansas, is one of the largest refrigerated warehouses in the world, having capacity for 3,000 carloads. A temperature of 32 degrees F. is held in the great cave by two Frick

4-cylinder compressors, driven by motors totaling 600 horsepower.

For that important cooling job of yours, specify Frick air conditioning, refrigerating, ice-making or quick-freezing equipment.

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Frick Compressors with Motors Totalling 600 Horsepower, at Natural Cooler Storage.

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Sole Builders of Power Farming and Small Machinery



Is a cable covering flameproof? Will it resist high temperatures when it comes to actual service?

Long before a cable is manufactured, questions like these are answered in the Okonite laboratories, proving ground and in various testing departments of the Okonite plants. The picture above shows a flame test. The measured current that makes the coils glow makes it possible to reproduce test after test without variation. The Okonite Company, Passaic, New Jersey.

**OKONITE** OKONITE SINCE 1878  
insulated wires and cables

### Cathode-Ray Oscillograph

(Continued from page 22)

can be solved with the aid of a general purpose oscillograph, there do exist more complicated oscillographs designed to perform special functions. For applications involving rotating machinery and, particularly, internal combustion engines, there is the cathode-ray polar-coordinate indicator, which employs a circular time base. In addition, there is a dual-beam oscillograph, which makes it possible to display simultaneously two or more phenomena on the same cathode-ray tube. This instrument contains two independent Y-axis amplifiers, two independent X-axis amplifiers and two independent sweep circuits. Certain oscillographs may contain precision expanded sweeps or sweep delay circuits for accurate timing and measurement. With such an oscillograph it is possible to select a single line from a television picture for critical study or recording. These are perhaps some

of the most advanced of modern day oscillographs.

When applying a cathode-ray oscillograph to a particular problem, it should be realized that this instrument does not offer any solution to the problem. Rather it will supply information or data much the same way as a voltmeter will. Nor is the oscillograph a corrective instrument, which performs a specific operation on an electrical signal. Yet, when in the hands of a skillful operator its possibilities are practically unlimited.

Today, an important use has been found for the oscillograph in almost every branch of science and industry. In many cases it has saved valuable man-hours and countless dollars. In other cases it simply would have been impossible to obtain certain desired information without the use of such an instrument. However, even as new uses are being found daily for the cathode-ray oscillograph, research is still progressing which will further make it an indispensable tool to scientists and engineers.

### Techni-Briefs

(Continued from page 26)

detected by a new "neutron counter tube." The counter tube, shaped like a policeman's night stick, will be useful in monitoring an area near atomic piles or atom smashers before laboratory workers are admitted to the area. The counter tube will indicate whether neutrons have penetrated the shields installed for protection against radiation exposure. Basic part of the detector is the tube's lining of boron, which has a special molecular property enabling it to capture the slow-moving neutrons. When a neutron strikes a boron atom, two particles are exploded outward in opposite directions. These particles hitting the argon gas with which the counter tube is filled cause surges of electricity from the wall of the tube to a wire stretched down the tube's center. Each surge of current through the wire is counted and the count is proportional to the number of neutrons striking the counter tube.



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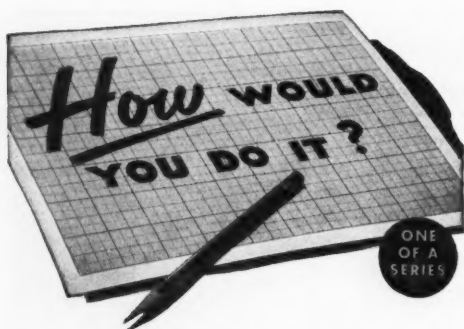
You just know she'll wear them!

♦ ♦ ♦

## THE CORNELL CO-OP

BARNES HALL

ON THE CAMPUS



**PROBLEM**—You are designing a telescoping radio antenna for automobiles. You want to provide a means for extending and retracting the antenna sections from a convenient point inside the car. How would you do it?

**THE SIMPLE ANSWER**—The illustrations show how one manufacturer did it—with two S.S.WHITE FLEXIBLE SHAFTS. One shaft, operated from the control knob, turns a reel at the base of the antenna. The other, on the reel, pushes up and pulls down the antenna sections as the reel is turned. As S.S.WHITE shafts can be supplied in any length, this arrangement makes the antenna adaptable to all types of cars and other motor control shaft vehicles.



Photos courtesy of L. S. Brack Mfg. Corp., Newark, N. J.

This is just one of hundreds of power drive and remote control problems to which S.S.WHITE FLEXIBLE SHAFTS are the simple answer. All engineers will find it helpful to be familiar with the range and scope of these "METAL MUSCLES" for mechanical bodies.

\*Trade Mark Reg. U.S. Pat. Off. and elsewhere

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It gives basic information and engineering data about flexible shafts and their many uses. We'll gladly send you a free copy on request.



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## *"Where opportunity knocks every day"*

This huge new building pictured above is one of the world's most modern petroleum research laboratories—those of the Standard Oil Development Company at Linden, N. J. It is the research center where Esso Products are constantly developed and improved by engineers and technicians whose aim is better products for better living all over the world.

Here chemists and engineers find limitless opportunities for the scientific

advancement of petroleum research. Scientific exploration in all the phases of oil production is constantly encouraged at Esso.

The 27,000 workers at Esso have been with the company an average of

13 years... 8,700 of them for 20 years or more. Esso is proud to have this large number of "career employees," enjoying fair pay, good working conditions, and a chance to learn more about the oil business and to advance in the company.

It has been an Esso Management policy for more than 30 years to keep good people happy at good jobs... and turn out consistently good products that carry the Esso trademark.



**ESSO STANDARD OIL COMPANY**

**Vol. 16, No. 2**

**31**

# STRESS *and* STRAIN...

The advocates of basic English disregard the fact that two statements, wording only slightly differently but having the same general meaning, can have entirely opposite effects. For instance, tell a girl that time stands still when you look into her eyes, and she will adore you; but just try telling her that her face will stop a clock!

\* \* \*

*Drunk in telephone booth:*  
"Number, Hell! I want my peanuts!"

\* \* \*

The brain of a college student is one of the most unusual things known to man. It starts to function the moment he jumps out of bed, and doesn't stop until he reaches the classroom.

\* \* \*

"Fishing?"  
"No, drowning worms."

\* \* \*

Boy: "Can you read my mind?"  
Girl: "Yes."  
Boy: "Go ahead."  
Girl: "No, you go ahead."

\* \* \*

*Not only is it proper to hold an engineer's hand in the dark, but it is usually necessary.*

\* \* \*

Father: "Why were you downstairs so long with that fellow last night?"

Sweet young thing: "Well, the least I can do when a fellow takes me to the movies is kiss him good-night."

Father: "That's true."

Sweet young thing: "Well, he took me to Ciro's."

First Engineer: "Let's cut psychology this morning."

Second Engineer: "Can't, I need the sleep."

\* \* \*

A farmer was phoning a veterinarian. "Say, Doc," he said, "I've got a sick cat. He just lays around licking his paws and doesn't have any appetite. What shall I do for him?"

"Give him a pint of castor oil," said the vet.

Somewhat dubious, the farmer forced the cat to take a pint of castor oil. A couple of days later he met the vet in town.

"How's your sick calf?" inquired the vet.

"Sick calf! That was a sick cat I had."

"My God, did you give him the pint of castor oil?"

"Sure did."

"Well, what did he do?" asked the vet.

"Last time I seen him," said the farmer, "he was going over the hill with five other cats. Two were digging, two were covering up, and one was scouting for new territory."

\* \* \*

Roommate: "Hey, wake up! There's a guy in here stealing your clothes."

Awakened: "What do you want to get me up for? You two just fight it out among yourselves."

\* \* \*

*Inebriated student (bumping into lamp post):* "Excuse me sir."

*(bumping into fire hydrant):*

"Excuse me, little boy."

*(bumping into second lamp post*

*and falling down):* "Well, I'll just sit here until the crowd passes."

I think that I shall never see  
A girl refuse a meal that's free;  
A girl with hungry eyes not fixed  
Upon a drink that's being mixed;  
A girl who doesn't like to wear  
A lot of junk to match her hair;  
But girls are loved by guys like me  
'Cause damn if I will kiss a tree.

\* \* \*

Prof: "Wise men hesitate, fools are certain."

Student: "Are you sure?"

Prof: "I'm certain."

\* \* \*

*She was only an EE's daughter,  
but she was easily induced.*

\* \* \*

Old Lady: "Don't you know that if you smoke, you'll never get to be President?"

Little boy: "That's all right, lady, I'm a Republican."

\* \* \*

"Get behind your lover, false woman," roared the Scotchman who found his wife in another man's arms, "I'm going to shoot you both!"

\* \* \*

*ME: "Why do the most important men on the campus always get the prettiest girls?"*

*Balch: "Oh, you conceited thing!"*

\* \* \*

Newsboy: "Extra! Extra! Read all about it, two men swindled."

Passerby: "Give me one—say, there isn't anything in here about two men being swindled."

Newsboy: "Extra! Extra! Three men swindled."





## How much magic can a square inch hold ?

**Just a frame of movie film—but think what it can hold. Accurate detail, motion, sound, even lifelike color and much more—miracles that work magic in entertainment, and in business and industry as well.**

Here, in a tiny area far too small to examine easily, photography has captured a moment of life faithful in its finest detail—captured it complete with sound—conversation and music. And all this that's been recorded can be endlessly duplicated so that all the world can thrill to its beauty and drama at the same time and in the language of any land.

Such are the wonders of photography. They are wonders that serve entertainment—can serve science, business, and industry in countless ways as well.

For example, motion pictures can present your product or services graphically and colorfully. They can explain production methods—dramatize safety measures—train salesmen. They can spark interest and understanding in the classroom.

With pictorial animation they can make difficult processes clear. They can make time go fast, go slow, or even backward, to facilitate a study or improve a demonstration. All of this because of the inherent magic in photography.

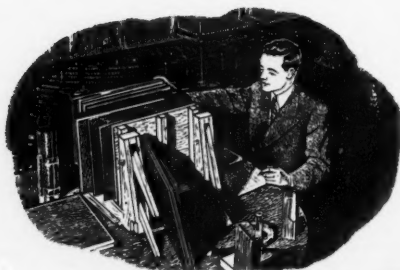
You can use this magic in your occupation. When you meet problems in production, management, or sales, it will pay you to find out how they can be handled better, faster, and more accurately through photography.

**Eastman Kodak Company, Rochester 4, N. Y.**

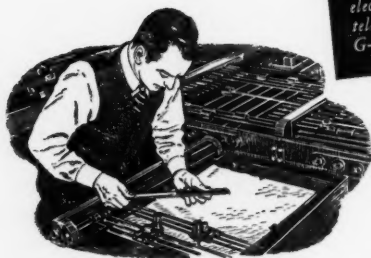
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**PHYSICISTS** at G.E. find opportunities in the Company's atomic research projects.



**MATHEMATICIANS** work on such G-E developments as the differential analyzer and other computers.

**ENGINEERS**—whether EE, ME, CE or other—have found work to their liking at General Electric. Here an electronics specialist works on television development in the G-E Research Laboratory.



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laboratories . . . in the engineering and developmental staffs of nine G-E Operating Departments, ranging from the manufacture of heavy industrial equipment to the making of lamps and chemicals . . . in manufacturing and sales . . . in such new undertakings as jet engines, radar, silicones, gas turbines for locomotives and electric power generation.

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